



Integrating Software and Hardware for New Observing Strategies

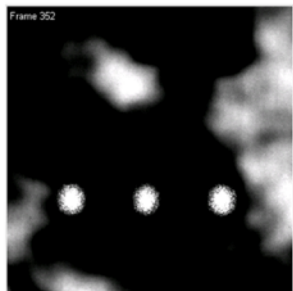
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Earth Science Technology Forum Panel Discussion
6/12/19

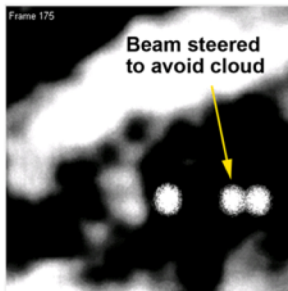
What does the future look like?

- Future satellite sensing missions will most likely include adaptive sensors working with resource constraints and in collaborating constellations
- Hardware already has these attributes/capabilities
- Science gains: better data quality, avoiding recording/storing useless data, rapid response to events, “synoptic” observation capability

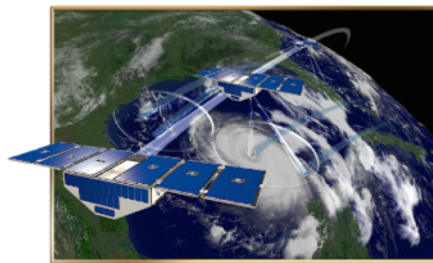
Default



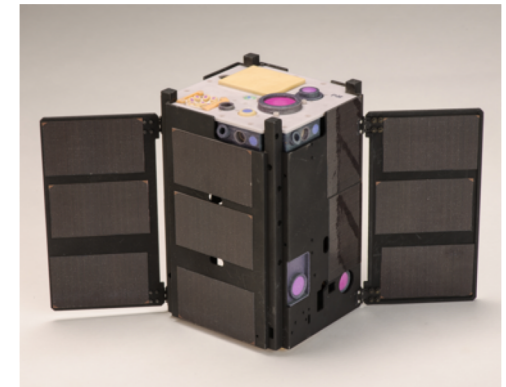
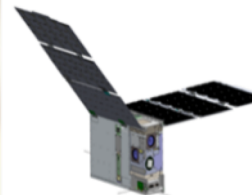
3 beam cloud avoidance demonstration showing default position of beams.



Beams are deflected to closest cloud-free position from their default position.



CYGNSS & CubeRRT small sat missions have started to highlight resource constraint challenge for future missions



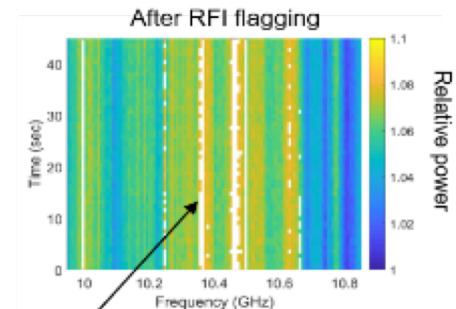
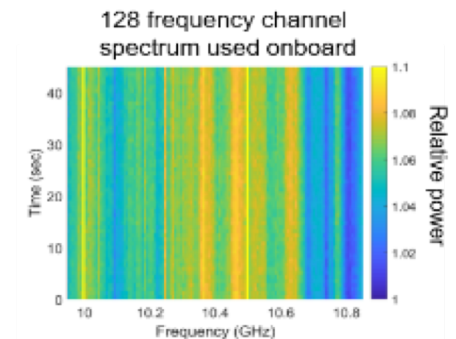
The Optical Communications and Sensor Demonstration CubeSats will demo high speed links an small sat collaboration

Ball Aerospace adaptive lidar system steering beams to avoid clouds

- All extend the traditional “fixed sensor” paradigm that our community is used to and comfortable with
 - Can we accept decisions about data acquisition being made autonomously? Key challenge is the perception of risk

CubeRRT Example

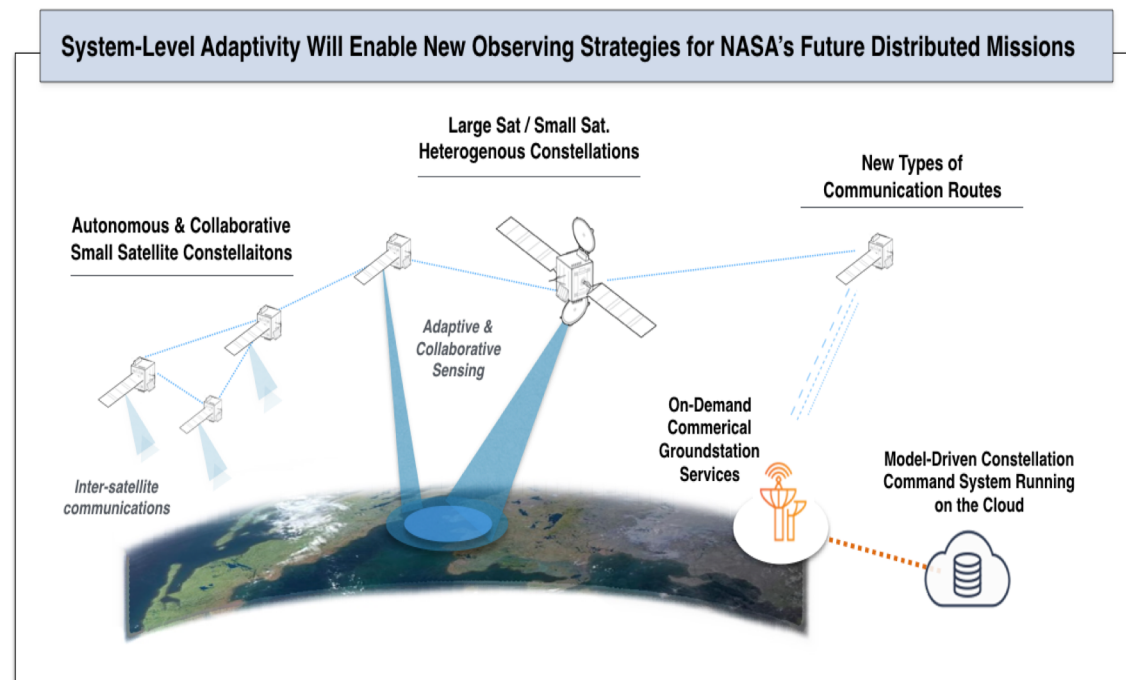
- Radio Frequency Interference (RFI) processor aboard the CubeSat Radiometer RFI technology validation (CubeRRT) mission autonomously flags and removes RFI from microwave radiometer observations
- Previously this had been performed on the ground at cost of greatly increased downlink bandwidth
 - Due to perception of risk in discarding potentially useful data
- CubeRRT RFI filtering is an “algorithmic” method that implements processing similar to that on the ground aboard the satellite
- This technology is essential for future Earth observing microwave radiometers given the increasing presence of RFI
 - We may not have a choice as to whether to allow on-board decision making!



White areas mark RFI removed

Addressing Risk

- As with any mission prep, we should take steps from mission simulations to ground or airborne demonstrations to space testing to full scale mission
 - A “full scale” mission here may be a constellation of distributed CubeSats with differing sensor sets
- OSU AIST project is developing the STARS library to facilitate mission simulations
 - Case studies show advantages of new strategies
- ESTO’s New Observing Strategies Testbed an important step for additional demonstrations blending software and hardware capabilities



Next Steps

- Continue building community awareness of capabilities of hardware/software in achieving
 - Sensor adaptation
 - Resource management
 - Collaborating constellations and systems
 - Autonomous decision making
- Continue simulations and demonstrations of New Observing Strategy systems
 - Intelligent Earth Observation Network proposed as a Design Reference Mission (DRM)
- Build interactions with science community
 - Atmospheric applications seems like a good first target
 - Experiences rapid change that is of high science interest
 - A+CCP mission formulation ongoing